Type
~~TITLE~~ I PROGRESS REPORT

Title: Recognition of the Geologic Framework of Porphyry Copper Deposits on ERTS-1 Imagery

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Contract: NAS5-21769

Objective:

The purpose of the investigation is to examine the general hypothesis that mineral deposits of the copper/molybdenum porphyry type occur in a characteristic geologic setting which is recognizable in the surface data on space acquired imagery.

Summary of Accomplishments - July and August 1973

The principal effort in this stage of the investigation is to reduce the geologic and geophysical data compilation of the six test sites to 1:1,000,000 scale maps and to produce geologic interpretaions of the ERTS imagery at the same scale.

A mosaic of 1:1,000,000 scale ERTS imagery over the Silverton Test Site and surrounding area has been produced and is being used to develop a set of tectonic map units having similar characteristics. These units are being "mapped" over the region. The principal criteria used in defining the tectonic units are:

a) Orientation of linear parallel and subparallel features.
b) Density of structural, stratigraphic and geomorphic features.
c) Relief
d) Relative abundance of rock types
e) Mode of deformation
f) Recognizable features which cannot be precisely defined in geometric terms.

The NE trending intrusive axis controlling the Silverton Caldera (part of the Colorado Mineral belt) was mapped with greater detail on January 30, 1973 coverage (1191-17204-6 and 1191-17202-6) than on imagery from September 27, 1972 and May 18, 1973. The contributing factor for this was the low sun angle (27°) of the winter time imagery vs. the higher sun angles (44° and 60°) of the fall and spring time imagery.

The Uncompahgre uplift and the regional structural trends of N40-50°W are easily identified on the ERTS mosaic. The ERTS mosaic displays a unique synoptic view of the intersection between the Uncompahgre axis and NE trending Colorado Mineral belt.

The construction of an ERTS porphyry tectonic map (transparency to mosaic) when finished will display the following data:

a) Lineations and structural interpretation from ERTS.
b) Tectonic units derived from ERTS.
c) Laramide and late Tertiary intrusions.
d) Location of mines.
e) Outline of regional gravity and magnetic anomalies.

Color composites of the Ray, Arizona Test Site (channels 4, 5, and 7) at a scale of 1:500,000 revealed more detail on hydrothermal alterations around known porphyry mine locations and greater detail on fault systems associated with porphyry mines than was previously possible on 1:1,000,000 scale imagery. This is especially true of a NE fault zone approximately 8 miles wide than runs through Ray, Posten Butte and extends on toward Sacaton.

U-2 photography over the Ray, Arizona Test Site was studied in the area of the volcanic fields in the Galiuro Mountains and in the Ajo area. Basaltic shield volcanoes are identified in the Ajo area. Satellitic cinder cones on en echelon faults may be recognized by the orange-red coloration of the infrared film. On the surface these cinders are oxidized to a brick red. Intrusive plugs of basaltic andesite with iddingsite are a light-gray color in contrast to the dark-gray olivine basalt flows. Caliche crusts on the basalt flows are well developed and easily identified. Ash-flow tuff sheets have been differentiated by color and texture in the Galiuro Mountains.

In the Ely, Nevada Test Site, the northeast-trending set of en echelon grabens and horsts that occur in the eastern Basin and Range Province north of Ely cut across the present north-trending ranges and valleys. The faults often refract through the range blocks following a more easterly direction. In the graben blocks the Oligocene volcanics are more completely preserved, and this is reflected in the aeromagnetic pattern. Identification of the older northeast graben blocks in the present valleys may be important in locating Eocene lakes with potential for petroleum productions as at the Eagle Springs field, Nye County.

ERAP U2 underflight coverage using 2443 color infrared film in the RC-10 camera was obtained for the block 38° to 39°30N between 117° and the California border. This type of photography appears to provide optimum information for photointerpretation of geologic features.

The Mt. Perry, Queensland, Australia Test Site imagery falls into two basic groups: 1) that which was obtained in November, 1972 through January 1973; 2) that obtained in August, 1972. Imagery obtained during the November to January Wet is virtually useless for this research. Every significant porphyry-type deposit - - Yeppoon, Dundar, Moomera -- is under clouds. Working with this imagery would not be a valid test of the data.

The second group of imagery, taken in August, for the most part is usable. However, it suffers the fate of almost all Australian imagery -- it appears to be badly over exposed, and prints have a washed out appearance. Either they are light grey or dark grey, depending on how processing attempts were made to compensate for the "over exposure", but detail is washed out in each case.

Of all these data, scene 1035-23221 is the only readily usable imagery in an area of porphyry-type mineralization. The area is near the towns of Biloela and Monto and is located in the Monto and Munduberra 1:250,000 sheets. Unfortunately, all copies of imagery for this frame have an annoying split image -- black and white as well as color. Following are some tentative conclusions reached after inspection of this frame:

a) The false color composite is probably best to outline intrusions -- they generally have a distinctive vegetation developed on them and erode with an intricate dendritic drainage pattern.

b) The prominant NNW striking fracture set is well displayed on MSS 6, 7, and the color composite.

c) A northeast trending zone of weakness along which intrusions are implaced can be recognized. This zone was not previously mapped on the QGS 250,000 scale map but its existence was suspected from available geologic maps based upon elongate intrusions and other geologic features.

Problems

1) Owing to a very high reflectance of the Australian environment the Queensland imagery appears to be over exposed.

2) In the Queensland area the age of mineralization is pre-Mesozoic and has been followed by extensive erosion in which a Mesozoic peneplain or pediplane was developed and this has been followed by development of a series of Cenezoic peneplains and pediplanes. These widespread erosion planes with deep

soil and laterite serve to confound photo interpretation.

3) Cloud cover is still a problem in the Mt. Perry, Ok Tedi, and Silverton Test Site areas.

4) The correlation of schedules of seven co-investigators has proven difficult as regards the planned meeting with Earth Satellite Corporation to score their "naive" interpretations, review their progress in other areas and utilize their expertise and equipment to solve special problems. Plans were cancelled for a meeting in the subject reporting period.

Data Request Forms

1) July 27, 1973 (Tanacross Test Site)

2) July 30, 1973 (Ok Tedi Test Site)

Plans for Next Reporting Period

1) Continuing analysis of ERTS-1 imagery and compilation of observed features on base allowing comparison to known mineral occurrences, geology, and geophysics. Map compilations are being reduced to 1:1,000,000 scale.

2) Aeromagnetic data compilation will continue and interpretation for comparison to ERTS imagery may be initiated.

3) A meeting at Earth Satellite Corporation's facilities in Berkeley, California is planned in the next reporting period for the purpose of scoring their "naive" interpretation against readiness files compiled by co-investigators to aid in interpretation of problem areas.